Diseases of Antarctic Birds

A current review of Literature

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ABSTRACT

The review will be in the same format as presented in Kerry & Riddle (2009) *Health of Antarctic Wildlife*. The diseases of Antarctic birds are split into sections according to organism. Each group is tackled in turn and the prevalent illnesses discussed. The findings are that there is no one prevalent disease of the Antarctic Bird population. There is also not one specific ailment that affects particular birds. Penguins and Skua are equally as likely to obtain a tick infestation. Endo/Ectoparasites are the main problems facing birds but have been prevalent for many years. Viruses and bacterium are a newer threat but just as deadly, and in some cases more so due to the changing climate. But it is without the conjunction of both parasite and organism that makes establishment difficult.

The health of the Antarctic bird population is a primary concern for almost all people. The charismatic presentation that penguins and other such birds of the isolated continent, is often however overlooked. Overall there is a large lack in accurate and current research on the diseases of Antarctic birds. Most of the information available has been done prior to the 1980s and is only just showing another boom now.

The major affects that the human population is having on this ecosystem is still unknown. There have been cases of Cholera and Influenza in Antarctic birds as well as the presence of human gut micro biota. This is a sign that somewhere in the past or present, we as visitors, are not being cautious enough. For bio security to be effective we must first know out enemy. As the climate is warming the possibility for invasion is becoming more apparent. Antarctica is cold and dry thus has been highly selecting for the diseases that can survive there, especially when in contact with the outside environment. Therefore it is highly important that more research is occurring to ensure we can protect Antarctica and its wildlife to the best of our ability.

Diseases of the Antarctic bird population

Ectoparasites:

Surprisingly there is a large diversity of Ectoparasites that live within the animal population of Antarctica. They range from ticks to lice as well as fleas and mites.

Ticks feed off primarily mammals and are split into two groups; soft and hard ticks. The Ixodidae group is the most common tick found in Antarctic birds, effecting both flying and diving birds. *Ixodidae uriae* is found widely were hosts are available. *I. uriae* has been found in 45 different host species as well as in minor abundance within royal Albatross (Jones, 1988). The presence of the tick has been thought to effect albatross chick populations but Bergstrom, Haemig, and Olsen (1999) has shown otherwise. Even in densely infected areas there has been no mortality bias towards infected birds. Investigation has found that colonies of Gentoo penguins have changed nesting sites every year to avoid tick infestations (Major, Linn, Slade, Schroder, Hyarr, Gardener, Cowley and Suhrbier 2009). There has been no report as to why this is the case. It can only be speculated that it has just been a part of their natural life cycle. A further problem with ticks is their diet. Ticks are prone to act as secondary vectors for blood borne viral disease. The most prominent of these viral diseases will be discussed in the virus section.

Mites are also a common nest inhabitant of many birds including those in the Antarctic. There are many species of feather mite as well as those present in the nasal passage. *Rhinonyssus schelli* has been found within Adelie penguins (Watson 1975 cited in Woods, Jones, Watts, Miller, Shellam, 209). As yet there has only been a few species collected.

Lice form a large part of the insect population within Antarctica. Highly parasitic, Mallophaga species display large host specificity and make up almost the entire group of lice present. Block (1984)have shown that there are at least 60 species of lice in south polar birds including a specific genus which effects the feathers of penguins (as cited in Woods et. al. 2009). It is thought however that lice do not transmit infectious blood borne agents.

Fleas have thought to have come from primarily from South America and Australia. There has only been one species of flea found on the continent (*Glaciopsyllus antarcticus)* with many other species found on sub-Antarctic islands (Jones, 1988). Because of the high density of penguin feathers, invasion with any ectoparasite can be damaging. They force expansion between the feathers and can lead to water pockets in the skin. This water flow will decrease the internal body temperature of the bird. The heat loss will lead to further energy needed to retain the desired temperature. This extra energy expenditure in conjunction with the skin irritation, no doubt makes it uncomfortable for the bird in question.

A greater problem is that ectoparasites often act as vectors for more invasive disease. This may be in the form of viral, bacterial or protozoan agents. (Woods et. al. 2009) Within temperate regions parasites play an important role in the longevity, transmission and foundation of disease within groups of animals. Although not proven as yet in the Antarctic, is a plausible model for much of the transmission of avian disease in the area.

Endoparasites:

The effects of endoparasites within Antarctic seabirds are not yet known. Parasites themselves are known to have major effects within animal populations in warmer areas. They can skew morbidity, mortality and birth rates. The parasite themselves are often passed through the normal method of the food chain before “establishing” in the preferred host. Once within the host they can have a diverse range of effects from simply placing a large energetic demand to alternation of behaviour. (Woods et. al. 2009)

Helmiths are large and diverse in order, and have found a natural host within all seabirds. Worms have been found as early as the 1910 British Antarctic expedition. Skua, Emperor and Adelie penguins' as well as the black browed albatross were all shown to contain one form or another of helmith (Woods et. al. 2009). It is important to note however that up until the 1940s most specimens were collected opportunistically, therefore prior health of the animal could not be obtained. So far, early (1965-1990) research on petrel and kelp gulls obtained positive results, with one case, 17 out of 17 Antarctic petrels found had tapeworms (Jones 1988). Tetrabothrius is found in large numbers consistently in petrels. There has been no other helmith type found in the petrel gut. There is dispute as to where the original infection was obtained. Some think acquisition occurred at the northerly wintering ground as apposed to the southern breeding ground (Woods et. al 2009). Others from the southern breeding ground and is carried with them back to the northern winter ground. There has, as far as I am aware, been no research to prove either camp.

There is no large population of protoza within the Antarctic seabird population. There have been recorded incidences of *Hepattozoan albatrossi* infections within several birds. The shared vector *I. uriae* by penguins and albatross is thought to be the carrier (Woods et. al. 2009, Jones 1988). Overall there is a large lack of suitable vectors for carriage of this type of blood borne disease. It is however difficult to detect due to its subclinical nature. Unless there is a secondary infection often primary mortality is low (Woods et. al. 2009).

Viruses:

Viral infections within sea birds are relatively common, but are focused towards several groups only. Paramyxoviridnae, avian flu, birnaviridae and arboviruses cause the majority of cases and have been the primary focus in Antarctic birds (Woods et. al. 2009). Most studies of viral disease come from serological evidence due to the invasive nature and multiple samples needed for accuracy of diagnosis. Majority of viral spread is via direct contact or through vectors (Austin & Webster 1993). Because of the close proximities of some bird communities the faecal oral route is also common. There have only been two recorded viral infections causing death among penguins. Puffinosis was observed in gentoo penguin chicks, on Signy Island, causing the death of several hundred chicks (Watts, Miller, Shellam 2009). Watts et. al. (2009) also mentions a large die off of well nourished Adelie penguin chicks at Mawson station. 65% were recently dead with others unable to stand and uncoordinated. Apart from these select few viral infections Antarctic birds are relatively disease free (Gardner, Kerry, Riddle & May 1997).

Avian paramyxoviruses (APMV) are hugely widespread among the general bird population. Within the group there are 9 serotypes all of which vary in virulence. 6 isolates of APMVs have been obtained from penguins on Macquaire Island, and found as far down Cape birds on Ross Island (Woods et. al. 2009). Newcastle disease has shown to be prevalent in a number of differing Antarctic bird species but is highly unpredictable. Antibodies to a number of viral diseases have been isolated from multiple locations and affect a diverse range of birds. From this it can be concluded that APMVS are endemic in the Antarctic region and due to the unpredictable nature are widespread. All of the diagnoses from Antarctic birds are from observation of by the presence of antibodies within bloody samples (Austin & Webster 1993)

Avian influenza (AI) is a major issue world wide. This has been emphasised with the recent publicity of Bird Flu. The wild bird population act as a reservoir for many of the flu strains that cause illness in humans. An understanding of the relationship between virus and bird in the wild population allows for better control. Ross Sea skuas have shown to have antibodies to AI as well as Adelie, Chinstrap, Gentoo and Giant Petrels. The consistency of isolates is thought to be due to reoccurring introduction of disease. (Woods et. al. 2009). The geological variation of isolates could also be due to the skua feeding patterns. Skua feed on the dead and eggs which could have died from AI. The transmission therefore could occur were contact with other birds is made (Austin & Webster 1993). Dispite attempts, no AI viruses have been isolated from Antarctic birds.

Birnavirus is common in domestic poultry, causing infectous bursal disease virus (IBDV). Once the animal becomes infected, the lymphiod organs are targeted which in turn leads to immunodefficency in young birds. It is tested for via antibodiy titres or serum testing. All of which are primarily testing blood, as IBDV is hard to visualise in infected patients. 65% of Emperor penguin chicks and over 2% of Adelie penguins from Mawson Station colonies had positive anitbiodies to IBDV (Gardner, Kerry, Riddle & May 1997, Watts, Miller & Shellam 2009). It is interesting to note however there were no positive samples found around Edmunson Point. IBDV is highly contagous as well as being resistant to dessicaction, envirometnal extremes and chemical agents. It has been known to maintain virulent for monnths within poultry pens, feed and faeces (Watts, Miller & Shellam 2009). Due to its spread via the feacal oral route, infection is thought to have arisien from envirometnal contamination and inapropriate disposal of poultry, although flock spread is just as likely. A further study by Gauthier-Clerc et. al. (2002) showed that 96% of Emperor penguin chicks of Edmonson Point were positive for IBDV (cited in Woods et. al. 2009). Many other later studies have also been done on other rockeries, and other species of penguins which contradict Gardner et. al. results of human dispersal. IBDV is widely spread throughout Arctic penguin populations (Woods et. al. 2009) and is also present in Skua (8-17% prevalence). Once in a population, transfer is rapid with up to 100% sero-conversion post initial exposure (Watts, Miller & Shellam 2009). The high antibody prevalence within Emperor penguins chicks shows that infections occur repeatedly every year. Because emperors breed on the ice which is prone to melting, environment is the unlikely source. It is suggested that the adults at as carriers (Watts, Miller & Shellam 2009) spreading infection via incidental ingestion.

Arboviruses are arthropd-bourne viruses. They are spread via an intermediate vector, such as an insect or other arthropod, in which the virus replicates. When the insect takes meal from the animal, virus is transferred insidently via the blood. Little is known about these viruses in birds despite extensive work (Woods et. al. 2009). Flaviviruses have been isolated from *I. uriae* ticks found in close contact with penguin colonies. To support this research antibodies to Flaviviruses were also found in the birds from the colonies at which the ticks were also sampled (Major et. al. 2009). Flavivirus antibiodies have also been present in Skua tested in the same project. Due to anitgentic similarity of the Skua and penguin virus isolates suggestion is that migratory birds are incidentally carrying the virus (Woods et. al. 2009).

Other Problem viruses:
Egg drog syndrome caused via the avain adenovirus within 1976 has been found in small numbers in Adelie popluations. The antibiody was present for many astrual summers over a diverse range of locations. Eggs Drop syndrom causes a decrease in egg production and quality, thus lowering the breeding success. Further information is needed in this area to determine the extent, if any, on the success on birds in the affected areas (Woods et. al. 2009). The presence of multiple viruses within a singular tick is possible. Orbivirus, phlebovirus and nairovirus have all been found in tick samples collected by Major et. al (2009). Many of these viruses and their resulting diseases are common in Arctic bird populations. So it is just a matter of time before they take a foot hold in the Anarctic. This emphasizes the role bio security plays in the well being of the wildlife.

Bacteria:

Bacterial infections are not common place in the wild bird population. Often they act in conjuction with virial infections or physical trauma to cause harm.

Avian Cholera is a newly emerging threat to the antarctic bird population. Found more often in flying birds such as Skua and Albatross it is starting to affect Adelie as well as Kelp gulls (Leotta, Chinen, Vigo, Pecoraro & Rivas 2006). Skua and Adelie predominantly have sub acute and acute disease. Kelp gulls more often show chronic infection. Typically *Pasturellia multocida* causes only an acute infection in the wild bird population. It causes varrying rates of mortality and morbidity due to the underlying issues of the individual. Transmission is often via water systems or aerosalised. This is emphised by the diseased populations all surrounding infected waterways. It is the lake conditons that have helped support life of the bacterium. The Antactic phentoype and gentoytype of *P. multocida* show persistence and stability giving evidence that it has it originated from a specific microbe. Recently there have been two outbreaks of avian cholera in Hope Bay over two summers (Loetta et. al. 2006). Recorded outbreaks have been occuring as early as 1979 (Woods et. al.) but are concentrated around the pensulia area where the environment is more temperate. Major mortality is not an issue.

Birds often have highly diverse range of gastrointestianl flora and Antarcitc birds are no accpetion. The diving petrel proved to have the most diverse gut biota of all Antarctic birds. Due to many of the constraints that Antarctica has, many faecal samples lose value very quickly and unavoidably. This lack in perfect laboratory conditiions has resulted in the loss of many original organisms. *Salmonella enterica* which is prevalent in humans and domestiated animals have been isolated from Adelie penguins suggest some form of human impact. (Woods et. al. 2009) Campylobacter sp. has also been found across a diverse range of areas in indeigenous Antarctic birds (Smith and Riddle 2009). One of the concerns is that of human bacterium causing problems in the bird population due to ingestion of waste water near stations. Although large numbers of antibotic reisitant bacteria have been isoated from sewage outlets around occupied areas, there was no aquired antibiotic resistance detected in isolates from Penguins or Skua. Despite the entry of bacteria of concern into the environment Antarctic birds are yet to be colonised by human coliforms. Smith & Riddle (2009) have shown coliforms (such as, but not limited to *Clostridium*) were concentrated in the mollusc population and could act as further transmission into the food chain.

Conclusion:

Caution needed when mass mortalities occur as to not to jump to a conclusion that may cause bias. A study by Kerry, Irvine, Beggs & Watts (2009) came across a large group of dead penguins during egg lying season. Feeling this as unusual they investigated further. Although preliminary thoughts jumped to and infectious disease, more in-depth investigation proved it to be severe traumatic injuries. These injuries were caused by the crushing force of the ice at the sea-ice –land interface. This example is important to show that mortality is all part of the natural selection process. Just because there is a mass mortality doesn't mean that an infectious agent is involved. In many cases infection only causes acute infection and it is only when a secondary event occurs that fatality is the end point. This is especially prevalent in the wild bird population.

There has been coverage of the majority of prevalent diseases in Antarctic birds in this review. It has not, however, covered every avenue. Fungal infections such as Aspergilliosis and Toxicities have not been mentioned. Within the subject headings there has also been artistic licence as to which of the multitudes of diseases were expanded upon. In all cases only those with prevalent recent and in depth data were used. Because of the ever changing environment that Antarctica is, it is important that the information that is available is a recent as possible. Overall, there is a large lack of diverse and in depth information available on a wide range of areas. Although antibodies and serum testing have shown the prevalence of some diseases, in most cases the bacterium or viruses has not been isolated. Without knowledge on the issues, projections for the future cannot be accurately made. Little is known about the impacts and importance humans have on the bird populations at this stage and even less is known about the impact of current ailments and how they may change with the climate. Climate warming may lead to the introduction of new pathogens and vectors as well as the expansion of the current isolates.

Antarctic Avian disease is an important key for the maintenance of a healthy overall population. Without a strong set of base information it is hard to judge what would be out of the ordinary, in the case of morbidity and mortality. A base line is also important to set clear needs and priorities of future research and management. To conclude, as vast amount of further research is need in the area of Antarctic Avian health.

References:

Austin, F.J., Webster, R.G., 1993 '*Evidence of ortho- and paramyxoviruses in fauna from Antarctica'*, Journal of Wildlife diseases, 29 (4), pgs 568-571

Bergstrom, S., Haemig, P.D., Olsen, B., 1999 'I*ncreased mortality of black –browed albatross chicks at a colony heavily infected with the tick Ixodes uriae',* International journal for Parasitology 29, pgs 1359-1361

Gardner, H., Kerry, K., Riddle, M., May 15th, 1997, '*Poultry virus infection in Antarctic penguins'*, Nature, Vol 387, pg 245

Geraci, J.R & Lounsbury V.J, 2009, 'Risk of marine mammal die-offs in the southern ocean' In Kerry, K.R. & Riddle, M.J., (eds) *Health of Antarctic Wildlife; A challenge of science and policy*, Springer, Heidelberg, Germany pgs 13-34

Griekspoor, P., Olsen, B., Waldenstrom, J., 2009, *'Campylobacter jejuni in penguins, Antarctica'* Emerging infectious diseases, Vol. 15, No. 5, May, pgs 847-848

Jones, H.L., 1988, 'N*otes on parasites in penguins (Spheniscidae) and petrels (Procellariidae) in the Antarctic and Sub-antarctic'* Journal of Wildlife diseases, 24 (1) pgs 166-167

Kerry, K. R., Irvine, L., Beggs, A., Watts, J., 2009, 'An unusual mortality event among adelie penguins in the vicinity of Mawson station Antarctica' In Kerry, K.R., Riddle, M.J., (eds) *Health of Antarctic Wildlife; A challenge of science and policy*, Springer, Heidelberg, Germany pgs 107-113

Kerry, K.R. & Riddle, M.J., (eds) 2009, *Health of Antarctic Wildlife; A challenge of science and policy*, Springer, Heidelberg, Germany

Leotta, G.A., Chinen, I., Vigo, G.B., Pecoraro, M., Rivas, M., 2006, '*Outbreaks of avian cholera in hope bay, Antarctica'*, Journal of Wildlife diseases, 42(2) pgs 259-270

Loettta, G.A., Rivas, M., Chinen, I., Vigo, G.B., Merdo, F.A., Coria, N., Wolcott, M.J., 2003, '*Avian cholera in a southern giant petrel (Macronectes giganteus) in Antarctica'* Journal of Wildlife diseases 39(3), pgs 732-735

Major, L., Linn, M.L., Slade, R.W., Schroder, W.A., Hyarr, A.D., Gardener, J., Cowley, J., Suhrbier, A., 2009, *Ticks associated with Macquarie island penguins carry arboviruses from four genera,* Plos one Vol 4 Issue 2, e4375, February 5th.

Palacios, M.J., Barbosa, A., Pedraza-Diaz,S., Ortega-Mora, L.M., Valera,F., Cuervo, J.J., Benzal, J., De La Cruz, C., 2010, *Apparent absence of Crytosporidium,Giardia and Toxoplasma godii in three species of penguins along the Antarctic Peninsula'* Antarctic Science 22(3) pgs 265-270

Smith, J.J. & Riddle, M.J., 2009, 'Sewage disposal and wildlife health in Antarctica' In Kerry, K.R., Riddle, M.J., (eds) *Health of Antarctic Wildlife; A challenge of science and policy*, Springer, Heidelberg, Germany pgs 301-316

Watts, J.M., Miller G.D., Shellam, G.R., 2009, 'Infectious bursal disease virus and Antarctic birds' In Kerry, K.R., Riddle, M.J., (eds), *Health of Antarctic Wildlife; A challenge of science and policy*, Springer, Heidelberg, Germany pgs 95-105

Woods, R., Jones, H.I., Watts, J., Miller, G.D., Shellam, G.R., 2009, 'Diseases of Antarctic seabirds' In Kerry, K.R. & Riddle, M.J., (eds) *Health of Antarctic Wildlife; A challenge of science and policy*, Springer, Heidelberg, Germany pgs 35-55